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14MTP14

First Semester M.Tech. Degree Examination, Dec.2014/Jan.2015
Thermodynamics & Combustion Engineering

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Thermodynamic data hand book is permitted.***

1 a. State the similarity between heat and work. Derive an expression for the displacement work by the system during polytropic process ($PV^n = C$) **(08 Marks)**

b. What are the limitations of first law of thermodynamics? **(02 Marks)**

c. 3kg of air kept at an absolute pressure of 100 KPa and temp of 300 K is compressed polytropically until the pressure and temperature become 1500 KPa and 500 K respectively. Evaluate the polytropic exponent, the final volume, the work of compression and the heat interaction. Take gas constant R = 287 J/kgK. **(10 Marks)**

2 a. Show that equivalence of Kelvin-Planck and classify statement of II law of thermodynamic. **(08 Marks)**

b. A reversible heat engine in a satellite operates between a hot reservoir at T_1 and a radiating panel at T_2. Radiation from the panel is proportional to its area and to T_2^4. For a given work output and value of T_1. Show that the area of the panel will be minimum when $\frac{T_2}{T_1} = 0.75$.

Determine the minimum area of the panel for an output of 1 kW if the constant of proportionality is 5.67×10^{-8} W/m^{2}K^4 and T_1 is 1000 K. **(12 Marks)**

3 a. Define available energy and unavailable energy. **(04 Marks)**

b. Derive an expression for availability for a closed system. **(08 Marks)**

c. Calculate the decrease in available energy when 25 kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and the temperature of the surrounding being 15°C. Take C_p of water = 4.2 KJ/kgK. **(08 Marks)**

4 a. Draw the phase-equilibrium diagram for a pure substance on h-s co-ordinates. **(04 Marks)**

b. Define a pure substance, triple point and critical points clearly. **(06 Marks)**

c. A certain gas has C_P = 1.968 and C_V = 1.507 KJ/kgK. Find its moleculer weight and the gas constant. A constant volume chamber of 0.3 m^3 capacity contain 2 kg of this gas at 5°C. Heat is transferred to the gas until the temperature is 100°C. Find the work done, the heat transferred and the changes in internal energy, enthalpy and entropy. **(10 Marks)**

5 a. Develop expression for the specific heat. Internal energy and enthalpy of an ideal gas. **(12 Marks)**

b. The following data were obtained with a separating and throttling calorimeter:
Pressure in pipe line = 1.5 MPa
Condition after throttling = 0.1 MPa 110°C
During 5 min moisture collected in the separator = 0.150 litre at 70°C
Steam condensed after throttling during 5 min = 3.24 kg
Find the quality of steam in the pipe line. **(08 Marks)**

6 a. Explain briefly: i) Law of mass action ii) order of reaction iii) First order reaction iv) Molecularity and v) Half life period. **(10 Marks)**

b. Differentiate between the premixed flame and diffusion flame. **(10 Marks)**

7 a. Define burning velocity. Explain briefly the factors affecting turbulent burning velocity. **(10 Marks)**

b. Discuss the mechanism of flame stabilization. **(10 Marks)**

8 a. Characteristic stability diagram. **(05 Marks)**

b. Combustion of a fuel droplet. **(05 Marks)**

c. Gas turbine combustion chamber. **(05 Marks)**

d. Rocket engine. **(05 Marks)**

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